"Insulating panel for thermal expansion compensation"

The present invention relates to an insulating panel of the "sandwich" type, in which a core of insulating material, generally a synthetic foam, is interposed between two outer faces made of metallic sheet.

These panels are commonly used in the construction of roofing and walls of buildings, prefabricated structures, industrial sheds and the like.

A problem which affects insulating panels made of synthetic foam lies in the fact that they have a low fire resistance, since the high temperatures associated with fire lead to detachment of the insulating foam from the metallic faces of the panel, with somewhat negative consequences.

In fact, under these conditions the mechanical properties of the panel are drastically reduced, since the latter no longer behaves as a single body: as a consequence its faces made of sheet metal, customarily ribbed or fretted, which contribute substantially to its flexional rigidity, do not co-operate with the intermediate core of insulating foam, so that there may be collapses in the buildings structures constructed with this type of panels.

In order to remedy this situation, from International Patent Application WO/9921712 in the name of Process Plastics Limited a composite panel is known in which the outer faces are made of thermoplastic material based on flame-resistant polyester or polycarbonate; between these faces is interposed an insulating core made of phenolic resin foam.

In order to increase the flame penetration barrier, in this panel a vitreous layer is applied between the outer faces and the insulating foam.

This panel is capable of remedying the drawbacks considered previously in relation to the deformation of the panels having faces made of metallic sheet; however, it is clear that having the faces made of plastics, it cannot have the same mechanical properties such as rigidity or others, as a metallic panel (obviously with equal dimensions).

The technical problem which the present invention aims to solve, is therefore that of producing a sandwich type panel having outer faces made of

metallic sheet and which is capable of remedying the drawbacks described above with reference to the current state of the art.

The idea for solving this problem is that of producing a panel able to compensate the thermal effects which occur when its faces are subjected to great differences in temperature, thereby increasing the resistance in the case of fire.

Such a panel is characterised in that between at least one of the metallic faces and the core of insulating material, a cushion of mineral wool is applied: this cushion in fact constitutes a fibrous layer, capable of absorbing the slippage which occur between the insulating core and the metallic faces in the plane of the latter, and of thermally protecting the core itself.

A panel structure of this type makes it possible to use for the insulating core both a synthetic foam, i.e. a deformable and combustible material which under normal conditions has a good capacity of adhesion and adaptation to the faces of the panel, and rigid slabs of perlite or another material which have a behaviour rather different from that of the faces.

According to a preferred embodiment of the invention, the mineral wool has a density of between 40 and 200 kg/m^3 and a thickness of between 10% and 50% of that of the insulating core; this thickness will depend on various factors, such as the type of insulating material selected, the dimensions of the panel, the presence of the mineral wool at one or both faces, the conditions of use of the panel, the degree of fire resistance required and the like.

Further features and advantages of the invention will become clear from the following description, relating to non-limiting embodiments thereof, shown in the appended drawings, wherein:

Fig. 1 is an axonometric view of a first panel according to the invention;

Fig. 2 shows the cross-section of the panel of Fig. 1;

Fig. 3 shows the cross-section of a second panel of the invention;

Fig. 4 is an axonometric view of a third example of panel of the invention.

As can be seen from the drawings, therein a whole sandwich type insulating panel is indicated by 1, having two visible faces 2 and 3 made of sheet metal; the metal of such sheets may be steel, copper or aluminium.

In this case the face 2, which is the upper face with reference to the figures, has high trapezoidal stiffening ribs 5 alternating with other smaller ribs indicated by 6, while the face 3, which is the lower face in the figures, has only light ribs 7; ribs of this type are however well known in the art and do not therefore require more detailed explanation.

Adjacent to the upper face 2 of the panel there is a core 10 of insulating material, typically an expanded synthetic resin which may be polyurethane, phenolic or some other resin; this material indeed permits complete filling also of the internal space of the deep ribs 5.

However, as will become clearer hereinafter, the insulating core 10 may also be constituted by a rigid slab of perlite or other similar material having good thermal insulation properties.

Between the core 10 and the lower face 3 of the panel 1, however, there is disposed a cushion 12 of mineral wool; the latter preferably has a density of between 40 and 200 kg/m^3 while the thickness S_c of the cushion is between 10% and 50% of the maximum thickness S_p of the panel 1.

The latter is produced by fixing the cushion 12 of mineral wool to the lower face 3 with a suitable adhesive, of a type which is known per se, and then causing the synthetic foam 10 to expand, as normally occurs in conventional panels.

In this way the cushion 12 is locked between the foam insulating core 10 and the lower face 3 of the panel: however, owing to its characteristics, the cushion 12 compensates for the thermal effects acting on the sheet metal with which the lower face 3 is formed.

In order to increase this result, according to a preferred embodiment of the invention the fibres of the mineral wool are predominantly orientated parallel to the faces of the panel; alternatively, the fibres are orientated in a direction partially

transverse thereto, that is to say, in a direction substantially perpendicular to the lower face 3.

From what has been stated hitherto, it is thus possible to understand how the panel 1 solves the problem underlying the invention.

This is due to the presence of the cushion of mineral wool 12, which makes it possible to absorb the thermal effects acting on the lower face 3 even in the presence of a high temperature gradient between it and the other face 2, for example owing to solar irradiation or to a fire as explained farther above.

It therefore follows that under such conditions the tensions induced in the panel do not bring about detachment of its components as occurs on the contrary in the prior art, so that it substantially retains its initial mechanical and physical properties; obviously in the case of fire these properties will remain unchanged for a time which will depend on the period of exposure to the flames.

In this context it should be observed that the cushion 12 of mineral wool fulfils various tasks.

The principal one is that of creating a thermal barrier in the case of fire, protecting the insulating core 10 made of synthetic foam, which has a low fire resistance.

The second is that it absorbs the differential thermal actions between the lower face 3 and the insulating core 10 because, as stated above, it does not transmit stresses in the plane of the panel; indeed the relative slippage due to the expansion of the metal is dispersed in the mass of the mineral wool fibres, without reaching the insulating core.

The third is that it can absorb the deformation deflection of the lower face 3, when the latter bows as a result of its thermal expansion.

The cushion 12 is in fact, within certain limits, compressible so that when the sheet metal forming the lower face 3 of the panel bows (upwards with reference to Figures 1 and 2), the cushion absorbs its deformation without inducing significant stresses in the remainder of the panel: obviously this effect will depend on the thickness of the cushion 12 and on the density of the mineral wool with which it is formed.

In this circumstance it should be emphasized that the latter, as can be seen, occupies only a part of the thickness of the entire panel (from 10 to 50%), so as to avoid the problems of condensation within the latter which can be observed in panels whose insulation is made entirely of mineral wool.

Moreover, the panel thus produced has insulating properties superior to those of the panels of equal thickness, but having an insulating core formed entirely of mineral wool.

Variants of the invention with respect to what has been disclosed hitherto are of course possible.

Mention has already been made above of the various materials usable for the insulating core 10, to which reference will be made again hereinafter.

It should then be pointed out that although in the panel of Figures 1 and 2 the cushion 12 is adjacent to the lower face 3, because this solution is without doubt the simplest, it could however be applied on the upper face 2 as well, inserting the mineral wool also into the ribs 5.

Moreover, it is also possible to have panels with two cushions of mineral wool, respectively adjacent to the faces of the panel; this solution is shown in Fig. 3 which illustrates the cross-section of a second example of a panel according to the invention.

In this figure the same reference numbers have been used to indicate the elements structurally or functionally equivalent to those of the first embodiment, adding 20 to each of the numbers; thus, the panel as a whole is indicated by 21, its upper face by 22, the lower one by 23, the insulating core by 30, and so on.

As can be seen, this second panel is symmetrical with respect to its median plane and is equipped with two cushions 32 of mineral wool adjacent to its faces 22 and 23, made according to the same criteria explained above.

It needs only to be stated that in this case it will be the overall thickness of the two cushions 32 which is between 10% and 50% of the total thickness of the panel.

The insulating core 30 may be made of polyurethane or phenolic foam, for which the same considerations stated previously apply; however, as an alternative

thereto, the symmetrical form and the substantially plane faces of the panel make it possible to apply a slab of perlite or of extruded or expanded polystyrene.

In a similar variant the slab will substitute, wholly or in part, the synthetic foam as insulating material, while the cushions 32 will be fixed to the slab by means of adhesive, likewise it occurs for the outer faces 22 and 23.

It is not difficult to understand that in this case too the panel makes it possible to obtain the same advantageous effects as the first embodiment, although it is heavier when the slab is made of perlite.

Last it should be stressed that the performance of the panel according to this invention may be improved, so as to render it also acoustically insulating.

For this purpose reference should be made to fig. 4 which shows from below a panel like that of fig. 1 (the same reference numerals have been used for sake of simplicity), wherein the lower face 3 is provided with a plurality of through holes 9.

The latter have a diameter from 2 to 4 mm and preferably 3 mm, and a pitch from 4 to 6 mm, preferably 5 mm; in any case the ratio empty/full should be of about 33 %.

This allows to take advantage of the sound absorbent properties of the mineral wool 12 which, being located adjacent the holed face 3, provides for the deadening of sounds passing through the holes 9.

As a final variant it should be pointed out that the invention applies also to curved panels, i.e., not flat like those shown in the drawings; this is an important result deriving from the fact of using a cushion of material such as mineral wool, which fits well with the various configurations possible for the panels.

All the variants referred to above, however, come within the scope of the following claims.